Abstract

The atmospheric boundary layer (ABL) is the lowest layer of the atmosphere where surface effects are felt on time scales of about an hour. While its properties are determined by the surface characteristics, season and synoptic conditions, they in turn determine convective cloud properties and are required for the representation of cloud processes in atmospheric models. Further, interaction of the ABL with the surface layer of the ocean is a key component of ocean-atmosphere coupling. ABL characteristics over ocean surrounding the sub-continent become very important for understanding the monsoon processes during the monsoon season because the roots of many monsoon systems, that give rain to India, are over there.

In this thesis data used are from three major field experiments namely the Bay of Bengal Monsoon Experiment (BOBMEX, 1999), Arabian Sea Monsoon Experiment (ARMEX, in two phases, ARMEX-I during 2002 and ARMEX-II in 2003), and Continental Tropical Convergence Zone (CTCZ) experiment (Pilot in 2009) which were carried out under the Indian Climate Research Programme (ICRP). While there have been few studies on ABL characteristics for individual cruises, a comprehensive study considering all available radiosonde data from the above cruises has been missing. This study fills this gap and focuses on the vertical structure of ABL using more than 400 high resolution Vaisala GPS radiosonde data collected over Bay of Bengal and Arabian Sea.

The study attempts at first to look at the ABL characteristics of individual cruises and then compare and contrast them over the Bay of Bengal and Arabian Sea. ABL height H_m, estimated by using virtual potential temperature (θ_v) profile, shows diurnal variation during weak phase of convection while maximum in early morning during active phase of convection. Different variables i.e. moist static energy (h), specific humidity (q),

convective available potential energy (CAPE), virtual potential temperature (θ_v) and equivalent potential temperature (θ_e) also differ during weak and active convection periods. Conserved variables mixing line approach gives the height up to which ground thermals penetrate in the vertical. This height, denoted by MH that represents the actual ABL height, is 2-3 times larger than H_m when shallow convective clouds are present. In general both H_m and MH are 20-30% larger over Arabian Sea compares to that over Bay of Bengal. Comparison of surface convective available potential energy (CAPE) and equivalent potential temperature (θ_e) between normal and deficit monsoon years shows that convective instability was as large in deficit years. This means that dynamic and not thermodynamics, controlled the occurrence of convection.